IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	HARTGROVE et al.	)	Examiner:	Steele, Jennifer A
Application No.:	10/810,386	)	Group Art Unit:	1771
Filed:	March 26, 2004	)	Confirmation No.:	8629
Docket No.:	03-336	)		

For: STRUCTURALLY STABLE FLAME-RETARDANT NONWOVEN FABRIC

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, the undersigned declarant, Herbert Hartgrove, do hereby declare and state:

1. I am a named co-inventor of the invention described and claimed in the above-identified patent application.

2. I am familiar with the subject matter, contents, and relevant portions of the prosecution history of the above-identified application including the Office Action dated September 4, 2007, and the references discussed therein including U.S. Patent No. 6,660,503 B2 to Kierulff et al.

3. I received a Bachelor of Science degree in Textile Chemistry at North Carolina State University in Raleigh, North Carolina in 1976. I have been employed in the textiles industry since then.

4. I am currently employed by Polymer Group, Inc. (PGI), as a Senior Development Scientist in the Industrial division since 1998. I have responsibility for developing home furnishings products.

5. I have over 10 years experience in development of nonwoven products, and over 30 years

experience in development of textiles.

6. I am named as an inventor or co-inventor in many patent applications filed worldwide on technologies related to nonwoven products and/or methods for making them, which include the following:

	U.S. Pat. No.	Title
1	7,232,468	Abrasion resistant and drapeable nonwoven fabric
2	7,188,397	Flame-retardant imaged nonwoven fabric
3	6,930,064	Flame-retardant imaged nonwoven fabric
4	6,905,524	Method of continuously dyeing nonwoven fabrics and the products thereof
5	6,832,418	Nonwoven secondary carpet backing
6	6,815,378	Abrasion resistant and drapeable nonwoven fabric
7	6,750,161	Stretchable laminate
8	6,695,941	Method of making nonwoven fabric for buffing applications
9	6,669,799	Durable and drapeable imaged nonwoven fabric
10	6,596,658	Laminated fabric with fire-retardant properties

7. In view of at least the facts set forth above and referenced in paragraphs 1.-6. above, inclusive of my indicated combined educational and practical experience, I believe that I should be considered an expert in the field of nonwoven technology in general, and nonwoven product constructions in particular.

8. I also understand that the U.S. Patent & Trademark Office has described the disclosures of Kierulff et al. in the Office Action of September 4, 2007 (page 4), as follows:

> Kierulff '503 teaches the advantages of cellulose derived fibers, composites and blends and their improved properties including flame retardant with increased softness (col 3, line 43-45 and col 6 line 66). Kierulff teaches cellulose derived fibers are natural fibers including lyocell, flax, ramie, vicose (rayon) and cotton (col. 6, lines 63-67). Kierulff teaches that a natural fiber of lyocell could be substituted for a synthetic fiber or a natural fiber in order to achieve the improved properties that include being naturally flame retardant.

9. Following an interview of this application conducted between my patent attorneys and the Examiners of record on October 17, 2007, I understand that the U.S. Patent & Trademark Office has further commented on the Kierulff reference in an Interview Summary dated October 19, 2007, as follows:

> Applicants may present evidence and/or arguments to establish that lyocell fibers as recited in the claims have a particular chemical structure which is different than that of the modified lyocell fibers of Kierulff. Such a showing would overcome the rejection of record. ... ...

10. My presently claimed invention is related to a structurally stable, hydroentangled, flame-retardant nonwoven fabric comprising a first and a second layer. The first layer is a blend of lyocell fiber and modacrylic fiber. The modacrylic fiber and lyocell provide fabric strength and soft hand, and form a char rather than melt when burned. The second layer is a blend of lyocell fiber, modacrylic fiber, and para-aramid fiber. The para-aramid fiber provides structural integrity and reduces thermal shrinkage. The lack of para-amid fiber in the first layer of the flame-retardant nonwoven fabric of the present invention masks the discoloration of the second layer that tends to occur from the presence of the para-amid fiber therein. The first and second layers are hydroentangled together at their interface.

11. Based on my review of the Kierulff et al. patent ("Kierulff"), this reference teaches chemical modification of oligo- or polysaccharides by an enzymatic process in which a phenol oxidizing enzyme such as peroxidase or lactase is used in combination with an enhancing agent in order to introduce new functional groups having covalent bonds attached in the oligo- or polysaccharide starting material, such as carbonyl groups and/or carboxylate (Abstract; col. 5, lines 56-64; claims). The enzymatic process described by Kierulff is technically understood to oxidize a certain hydroxy group or groups of a sugar monomer of the oligo- or polysaccharide

starting material (abstract), and introduces new functional groups (col. 2, lines 31-33, col. 5, lines 56-63). Kierulff states that the oxidation of cellulose initially results in formation of carbonyl groups with further oxidation resulting in formation of carboxylate groups (col. 3, lines 48-50, col. 4, lines 1-4). This outcome of this chemical reaction and modification can be measured by vibrational spectroscopy techniques (col. 4, lines 29-43, col. 11, line 63 to col. 12, line 9, col. 12, lines 59-63). Kierulff also states that the carbonyl/carboxyl groups formed by the enzymatic oxidative process are more reactive than the native hydroxyl groups (col. 6, lines 11-14). This is technically understood to mean that a product results from the process that is intrinsically different than the starting material. Kierulff further technically teaches that a new compound can have flame retardancy or other properties imparted by making further chemical modifications to the enzymatically-modified oligo- or polysaccharides (col. 6, lines 11-26). Kierulff does not appear to teach or suggest that lyocell itself is a flame retardant fiber. Moreover, Kierulff does not disclose any use of the lyocell fibers other than as a starting material for the enzymatic processing disclosed therein.

12. The term "lyocell" is a recognized term of art that has a ordinary and customary meaning that is technically understood by one of ordinary skill in the art to refer to 100% cellulosic fiber derived from wood pulp dissolved in a solution of N-methyl morpholine oxide or NMMO, and the resulting solution is spun into fibers and the solvent is extracted by washing the fibers, providing lyocell fibers. Technical literature in this field confirms that it is known that lyocell differs from other cellulosic fibers such as viscose because lyocell is made by direct dissolution of the cellulose in an organic solvent "without the formation of an intermediate compound," such as taught by "Regenerated cellulose fibres," edited by Calvin Woodings, 2001, Woodhead Publishing, pages 62-63 (copy attached as Exhibit 1). Thus, lyocell fibers, as properly defined,

are technically understood by a person of ordinary skill in this art to mean fibers that are 100% cellulose fibers, which are different chemically and structurally from the phenol oxidized, flame retardant products made in accordance with the processing of Kierulff.

13. In view of my foregoing technical explanations, it is my opinion that a person having ordinary skill in the nonwoven art would not have read Kierulff as teaching, suggesting or predicting the unexpected results obtained by the combination of lyocell with modacrylic in one fiber layer and in combination with modacrylic and para-armid fibers in another fiber layer hydroentangled thereto according to my invention.

14. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the instant application or any patent issuing therefrom.

Further Declarant sayeth not.

12/20/2007
Date

Herbert Hartgrove
Herbert Hartgrove

Exhibit 1

"Regenerated cellulose fibres",
Ed. C. Woodings, 2001, Woodhead Publishing, pages 62-63 (4 pgs. total)

Regenerated cellulose fibres

Edited by
Calvin Woodings

The Textile Institute

CRC Press
Boca Raton Boston New York Washington, DC

WOODHEAD PUBLISHING LIMITED
Cambridge England

Published by Woodhead Publishing Limited in association with The Textile Institute

Woodhead Publishing Limited
Abington Hall, Abington
Cambridge CB1 6AH
England
www.woodhead-publishing.com

Published in North and South America by CRC Press LLC,
2000 Corporate Blvd, NW
Boca Raton FL 33431, USA

First published 2001, Woodhead Publishing Ltd and CRC Press LLC

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library.

Library of Congress Cataloging in Publication Data
A catalog record for this book is available from the Library of Congress.

Woodhead Publishing ISBN 1 85573 459 1
CRC Press ISBN 0-8493-1147-0
CRC Press order number: WP1147

Cover design by The ColourStudio
Typeset by Best-Set Typesetter Ltd, Hong Kong
Printed by TJ International Ltd, Cornwall, England

4

Lyocell: the production process and market development

PATRICK WHITE MBE

4.1 Overview

Lyocell is the first in a new generation of cellulosic fibres. The development of lyocell was driven by the desire for a cellulosic fibre which exhibited an improved cost/performance profile compared to viscose rayon. The other main driving force was the continuing demands for industrial processes to become more environmentally responsible and utilise renewable resources as their raw materials. The resultant lyocell fibre meets both demands.

Lyocell was originally conceived as a textile fibre. The first commercial samples were produced in 1984 and fibre production has been increasing rapidly ever since. Fabrics made from lyocell can be engineered to produce a wide range of drapes (how the fabric hangs), handles (how the fabric feels) and unique aesthetic effects. It is very versatile and can be fabricated into a wide range of different fabric weights from women's lightweight blouse fabric through to men's suiting.

Other end-uses, such as nonwoven fabrics and papers, are being developed. These non-textile end-uses will become progressively more important as the special properties of lyocell fibres enables products with enhanced performance characteristics to be developed.

Lyocell is a 100% cellulosic fibre derived from wood-pulp produced from sustainable managed forests. The wood-pulp is dissolved in a solution of hot *N*-methyl morpholine oxide (abbreviated to NMMO or amine oxide in this text). The solution is then extruded (spun) into fibres and the solvent extracted as the fibres pass through a washing process. The manufacturing process is designed to recover >99% of the solvent, helping minimise the effluent. The solvent itself is non-toxic and all the effluent produced is non-hazardous.

The direct dissolution of the cellulose in an organic solvent without the formation of an intermediate compound differentiates the new generation of cellulosic fibres, including lyocell, from other cellulosic fibres such as

viscose. This has led to the new generic name 'lyocell' being accepted for labelling purposes.

Lyocell has all the benefits of being a cellulosic fibre, in that it is fully biodegradable, it is absorbent and the handle can be changed significantly by the use of enzymes or chemical finishing techniques. It has a relatively high strength in both the wet and dry state which allows for the production of finer yarns and lighter fabrics. The high strength also facilitates its use in various mechanical and chemical finishing treatments both under conventional and extreme conditions. The physical characteristics of lyocell also result in its excellent blending characteristics with fibres such as linen, cashmere, silk and wool.

In common with other highly oriented cellulosic fibres, such as cotton, cuprammonium and polynosic rayon, lyocell fibrillates but its ease of fibrillation is greater. Fibrillation becomes apparent when the fibre is abraded in the wet state and surface fibrils (small fibre-like structures) peel away from the main body of the fibre but remain attached. The fibrillation behaviour of the fibres can be exploited by using a variety of different mechanical, chemical and enzyme treatments to produce a vast range of fabric aesthetics. The control of the fibre's fibrillation behaviour, both to increase and decrease fibrillation, is a major area of continuing research.

4.2 Amine oxide technology – timeline

1939	Patent appears describing the dissolution of cellulose in amine oxide.
1966–1968	D L Johnson of Eastman Kodak Inc. publishes a series of papers discussing a range of compounds, including cellulose, which dissolve in amine oxide.
1969–1979	American Enka/Akzona Inc. work on spinning fibre from a solution of cellulose in amine oxide but decide not to scale up production.
1979	Courtaulds start research on the new cellulosic fibre, which is to become Tencel®.
1983	Pilot plant tow/staple line built in Coventry, UK.
1984	First commercial staple samples produced.
1988	Small commercial plant set up at Grimsby, UK.
1989	BISFA (Bureau International pour la Standardisation de la Rayonne et des Fibres Synthétiques) agrees to new generic name – lyocell.
1992	Full-scale production plant set up at Mobile, USA.
1996	Second stage expansion takes place in Mobile.